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ABSTRACT

This unit entitled "General Science" is one of a series of instructional guides prepared by teachers for the Sahuarita High School (Arizona) Career Curriculum Project. The package is subtitled "Physical Science in General Science" and consists of sections dealing with mechanics, electricity and light. A list of 41 behavioral objectives is stated which covers all aspects of the unit. The section on mechanics is divided into nine problems dealing with terminology, forces and motion, ideal mechanical advantage, vectors, levers, pulleys, and the inclined plane. Each topic includes a statement of the rationale, objectives, information sources, activities and post-evaluation. The section on electricity deals with six problem areas, and the section on light consists of eight. These problems are approached with a statement of the rationale or an overview, followed by a series of student activities. For related units in this series see SE 016 636 through SE 016 644. (JR)

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SAHUARITA HIGH SCHOOL

CAREER

CURRICULUM

PROJECT

COURSE TITLE: GENERAL SCIENCE

PACKAGE TITLE: MECHANICS

BY

LARRY CHRISTENSEN & ROBERT LANE

SE 016 635

GENERAL SCIENCE

OBJECTIVES

1. You will be able to define from memory 9 of 10 of the following terms: fulcrum, ideal mechanical advantage, force, a newton (nt), work, rector, friction, lever, pulley, inclined plane.

2. You will be able to state from memory Newton's three laws of motion with no mistakes.

3. You will be able to distinguish between speed and velocity.

4. Given the mass of an object and its acceleration, you will be able to calculate the force exerted between two bodies.

5. You will be able to calculate the ideal mechanical Advantage (IMA) of some simple machines.

6. You will be able to determine the force and direction of the resultant of 2 forces acting on a body by a graphical method.

7. You will be able to calculate the IMA of a 1st Class lever and list at least 5 examples of a 1st class lever.

8. Given a resistance and applied effort you will be able to design and build a 1st class lever that would do the job.

9. You will be able to calculate the IMA of a 2nd class lever and give at least 5 examples of a 2nd class lever.

10. Given a resistance and applied effort you will be able to design and build a 2nd class lever to do the job.

11. You will be able to list the job opportunities and requirements for a career in the field of transportation.

12. You will be able to list from memory 5 examples of a 3rd class lever.

13. Given a resistance and applied effort you will be able to design and build a 3rd class lever to do the job.

14. Given any pulley system, you will be able to calculate the IMA of a pulley system.

15. Given a resistance and an applied effort you will be able to design and build a pulley system to do the job.

You will be able to calculate the IMA of any inclined plane.

17. Given a resistance and an applied effort you will be able to design and construct an inclined plane to do the job.

18. Demonstrate in five ways how electrons react with other electrons, atoms, ions, and molecules.

19. Demonstrate how to use a galvanometer.

20. State a rule for the strength of magnetic field around a coil.

21. Demonstrate the voltaic pile.

22. Demonstrate the measurement of electrical potential (voltage) of various objects with a voltemeter.

23. Demonstrate the measuremnt of current (amperage) in an electrical circuit with an ammeter.

24. Explore skills and knowledge that are useful at home in working with electricity.

25. Explore some occupations in which electrical knowledge is necessary.

26. State Ohm's Law and discuss applications in your home and school.

27. State the uses of series and parallel circuits and demonstrate the proper connections for each type circuit.

28. Identify what light is and determine several ways it may be produced.

29. Identify or demonstrate certain properties of light such as illumination, travel, and intensity.

30. Demonstrate light travel, illumination, and image by use of a pin-hole camera.

31. Demonstrate that light travels in a straight line.

32. Identify units such as candles, lumen, and inverse proportion.

33. Demonstrate a standard measure of illumination by actual experimentation.

34. Demonstrate what happens when light hits various types of surfaces.

35. Define and demonstrate the "Law of Mirrors."

36. Demonstrate what happens to light when it passes thru vari. interfaces such as water-air, glass-air, and air-glass.

37. Identify the index of refraction for various substances such as glass, ice, diamond, and water and describe what this index might be used for.

38. To identify various uses of light, lenses, and mirrors for home, scientific, and industrial uses.

39. Identify the type of lens and demonstrate the arrangement of lenses used to form a microscope.

40. Identify the type of lens and demonstrate the arrangement of lenses used to form a refracting telescope.

41. Identify the type of lens and demonstrate the arrangement of lenses used to form a lens system for a box camera as well as a common 35 mm lens system.

1. Career Cluster
   A. Health
   B. Agri-business and Natural Resources
   C. Environment
   D. Public Service

2. Specific Career Areas
   A. Health Services and research
   B. Petroleum and related Products
   C. Production areas of Agriculture
   D. Research and production areas of Natural Resources
   E. Pollution control in Environment
   F. Extension programs in education

3. * Copy specific behavioral objectives from those listed in the unit.

Mechanics

Introduction

The dictionary defines a machine as "Any device consisting of 2 or more parts, which may serve to transmit and modify force and motion so as to do some desired kind of work."

There are many complex and sophisticated machines all around us yet all can be reduced to 4 basic elements. These basic elements have been known to man for over 2000 years. They are: the lever, the pulley, the wheel and axle and the inclined plane. In the following problems you will investigate each of these elements and some of their uses.

Problem 1

Mechanics - Terminology

Rationale:

In this problem you will learn the terms that will be necessary in order that we can communicate intelligently about machines.

You all know what work is, right? It's what makes you tired. A physicist has a more precise definition. He would say that if you lifted for 10 minutes on a 1 ton block but did not move it you have done NO work. So what is work?

Objectives:

1. You will be able to define from memory 9 of 10 of the following terms:

    1. fulcrum
    2. Ideal Mechanical Advantage (IMA)
    3. force
    4. a newton (nt)
    5. work
    6. rector
    7. friction
    8. lever
    9. pulley
    10. inclined plane

Information Sources:

1. Comptons Illustrated Science Dictionary
2. Glossary - Modern Science 3
3. Almost any other dictionary.

Activities:

1. Look up and write down the definitions for the words listed in Objective 1. Check your definitions with your instructor before taking the evaluation.

Post-Evaluation:

Write from memory the definitions listed in Objective 1.

Problem 2

Mechanics - Forces and Motion

Rationale:

In order that you may study simple mechanics you must first have some concept of force and motion. Every particle of matter in the universe is continually experiencing forces of one kind or another. One example is the force of gravity. Gravity is the force that gives each of us our weight. If you will recall in the 1st quarter last fall we said that your weight was dependent on the distance from the earth's center that you are standing. Therefore you would weigh more at the beach at Rocky Point then you would on Mt. Lemon. But your mass would be the same.

Objectives:

1. You will be able to state from memory Newton's three laws of motion with no mistakes.
2. You will be able to distinguish between speed and velocity.
3. Given the mass of an object and its acceleration you will be able to calculate the force exerted between two bodies.

Information Sources:

1. Read pages 92-102 in Modern Science 3.
2. Work out and hand in he 5 review questions on p. 102 in Modern Science 3.
3. Instructor lectures.

Activities:

1. Work out the following problems. Show all your work.

A. If a 100 kilogram paratrooper accelerates 9.8m/sec^2 as he falls from the airplane, what is the force of attraction between the paratrooper and the earth? (hint, $F = m^2$)

B. If a 30 kilogram ball is dropped from a tower and has an acceleration of 9.8m/sec^2, what is the force of attraction between the ball and the earth.

Quest:

Work out and hand in the following problem showing all your work.

What is the velocity of a .25 kilogram baseball if the pitcher exerts a force of 25 newtons during a .5 second throw before it is released?
(hint = see page 101 in Modern Science 3.)

Post-Evaluation:

1. State from memory Newton's three laws of Motion with no mistakes.

2. Distinguish between speed and velocity by writing a definition for each term with no mistakes.

3. Hand in problems 1A and 1B from the Activities section for grading.

4. Hand in your review questions from p. 102 in Modern Science 3 for grading.

Problem 3

Mechanics - Calculation of Ideal Mechanical Advantage (IMA)

Rationale:

Most machines are designed to give us some advantage, however some are simply to change the direction of the applied force. In this problem you will learn how to calculate the Ideal Mechanical Advantage (IMA) of some simple machines. When figuring IMA we do not consider any energy lost to friction.

Objectives:

1. You will be able to calculate the Ideal Mechanical Advantage (IMA) of some simple machines.

Information Sources:

1. Modern Science 3 p. 105-106
2. Patterns and Processes of Science p. 263
3. Instructor lectures

Activities:

1. Work the following problems, showing all work:

A. If; R = 5g

E = 10g

E_d = 2 cm

R_d = 4 cm

Then; IMA = _____

B. If; R = 3g

R_d = 4 cm

E = 6g

E_d = 1 cm

Then; IMA = _____

C. If; R = 10g

R_d = 7 cm

E = 35 g

E_d = 4 cm

Then; IMA = _____

D. If; R = 3g

R_d = 7 cm

E = 7g

E_d = 1 cm

Then; IMA = _____

Activities (cont'd)

E. $R = 5g$

$R_d = 5$ cm

$E =$ _____

$E_d = 10$ cm

$IMA = 5$

F. $R = 10$ g

$R_d = 5$ cm

$E = 2$ g

$E_d =$ _____

$IMA = 5$

G. $R = 100$ g

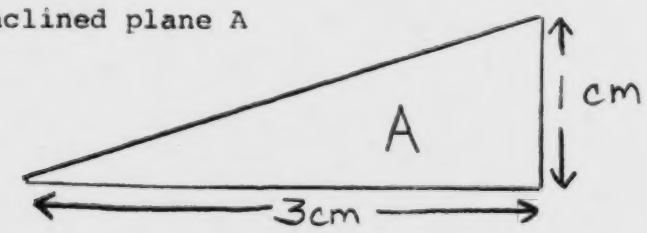
$R_d =$ _____

$E = 10$ g

$E_d = 30$ cm

$IMA = 10$

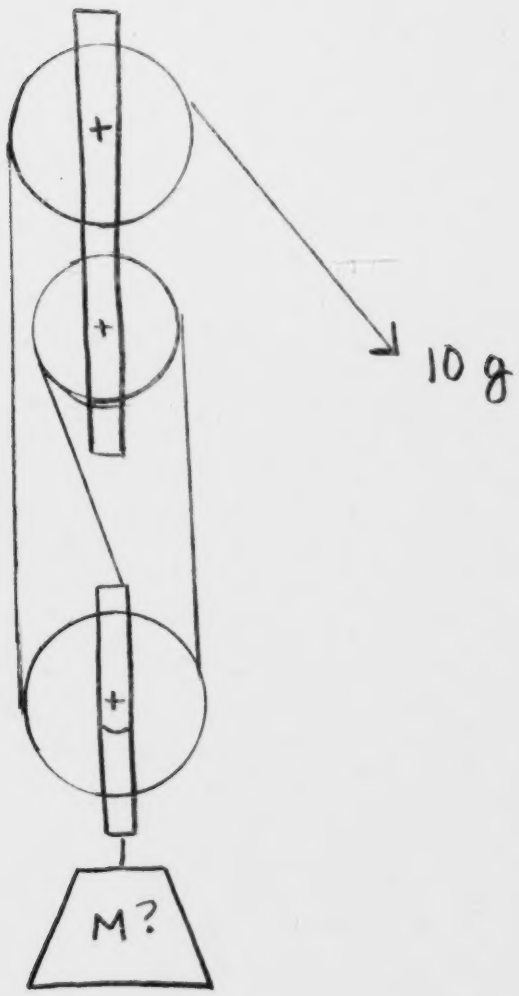
H. How much effort would it take to roll a 9 pound barrel up inclined plane A



Calculate the IMA _____

Activities (cont'd)

I. By applying an effort of 10 grams at the end of the rope in this pulley arrangement how large a mass could you lift?



Calculate the IMA _____

Post-Evaluation:

Obtain from instructor.

Quest:

Calculate the IMA for the following machine.

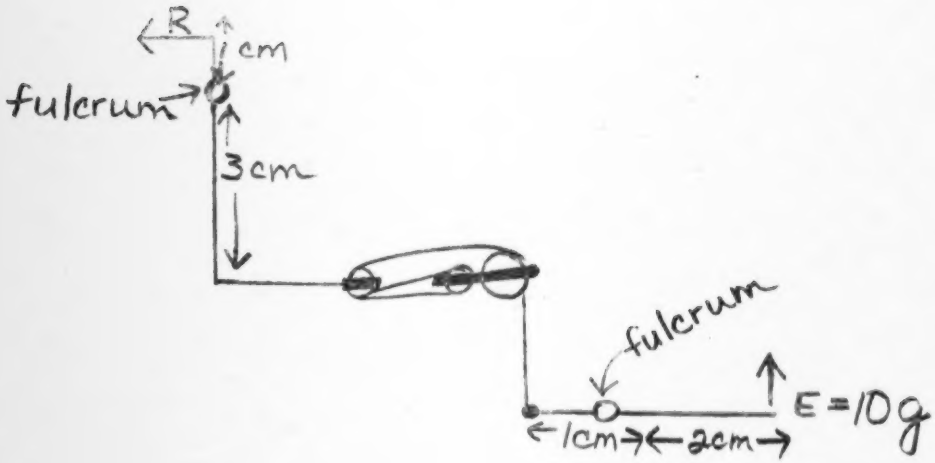
IMA for lever A _____

IMA for pulleys _____

IMA for lever B _____

total IMA _____

R _____ grams



Problem 4

Mechanics - Vectors

Rationale:

Forces have direction. A vector is a quantity which has direction. Velocity, acceleration and force are all vectors. Often two or more forces are applied to an object at the same time. Often it is necessary to know what the total force is and in what direction it is applied.

Objectives:

1. You will be able to determine the force and direction of the resultant of 2 forces acting on a body by a graphical method.

Information Sources:

1. Read pages 102-103 in Modern Science 3
2. Work and hand in review question 1, 2, & 3 on page 105 in Modern Science 3.
3. Instructor lectures.

Activities:

1. Complete and hand in Sheet M-1 "How do two forces affect a body's motion".

Post-Evaluation:

1. Hand in review questions 1,2 & 3 on page 105 in Modern Science 3 for grading.
2. Hand in Sheet M-1 for grading.

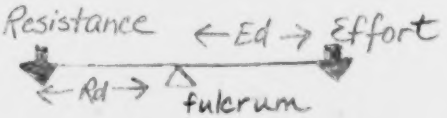
The following material has been deleted: How Do Two Forces Affect A Body's Motion?

Problem 5

Mechanics - 1st Class levers

Rationale:

When you were just a kid (you are now a young adult) you played on a see-saw or teetor-board, or whatever you called it. If you wanted to play with someone smaller than yourself you moved toward the middle of the board so you would balance better. Did you know that you were operating a simple machine, a 1st class lever?



Objectives:

1. You will be able to calculate the IMA of a 1st class lever and list at least 5 examples of a 1st class lever.
2. Given a resistance and applied effort you will be able to design and build a 1st class lever that would do the job.

Information Sources:

1. Read page 106 in Modern Science 3
2. Instructor lectures
3. Read pages 261-262 in Patterns and Processes of Science

Activities:

1. Work out and hand in sheet M-2 "How do Machines Increase Force".

2. There is a mass of 500 grams that you must lift and you only have 50 grams of effort that you can apply. Design a 1st class lever to do the job, calculate the IMA and show your design to your instructor. After your design has been checked obtain the necessary materials and build your machine and see if it does work. Have the instructor check your machine.

Post-Evaluation:

1. Hand in Sheet M-2 for grading.

2. You will be graded on the machine you built in Activity 2.

3. List from memory 5 examples of a 1st class lever.

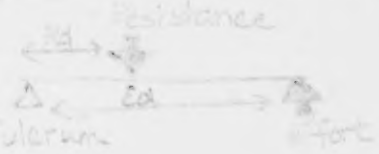
The following material has been deleted: How Do Machines Increase A Force I (Levers, Wheels and Axles)

Problem 6

Mechanics - 2nd Class levers

Rationale:

A man operating a wheelbarrow could be classified as a 2nd class lever operator. In a 2nd class lever the resistance sets between the effort and the fulcrum.



Objectives:

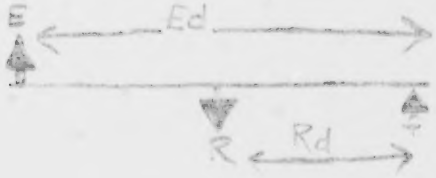
1. You will be able to calculate the IMA of a 2nd class lever and give at least 5 examples of a 2nd class lever.
2. Given a resistance and applied effort you will be able to design and build a 2nd class lever to do the job.
3. You will be able to list the job opportunities and requirements for a career in the field of transportation.

Information Sources:

1. Read page 108 in Modern Science 3
2. Read pages 261-262 in Patterns & Processes of Science
3. Instructor lectures

Activities:

1. Solve the following problems; show all work.



continued on next page

Activities continued

A. E = 5g

E_d = 3m

R = 10g

R_d = 1.5 m

IMA = _____

B. E = _____

E_d = 10 cm

R = 100 g

R_d = 20 cm

IMA = 2

C. E = 15 g

E_d = _____

R = 45 g

R_d = 50 cm

IMA = 3

2. There is a mass of 500 grams that you must lift and you have 100 grams of effort that you can apply. Design a 2nd class lever to do the job, calculate the IMA and show your design to your instructor. After your design has been checked by the instructor obtain the necessary materials and build your machine. Have the instructor check your machine.

3. Go to the library and list the job opportunities and requirements for a career in the field of transportation.

Post-Evaluation:

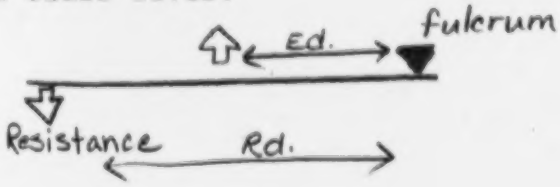
1. Have your problems checked by your instructor
2. You will be graded on the machine you built in Activity 2
3. List from memory 5 examples of a 2nd class lever.
4. Hand in your career report.

Problem 7

Mechanics - 3rd Class levers

Rationale:

A 3rd class lever has a different purpose than the previous two. It has a speed advantage rather than a force advantage. The effort applied will always be greater than the resistance but a small movement by the effort will cause a larger movement by the resistance. Your forearm is a good example of a 3rd class lever.



Objectives:

1. You will be able to list from memory 5 examples of a 3rd class lever.
2. Given a resistance and applied effort you will be able to design and build a 3rd class lever to do the job.

Information Sources:

1. Read pages 108-109 in Modern Science 3
2. Read page 262 in Patterns and Processes of Science
3. Instructor lectures.

Activities:

1. You have a 500 gram resistance that you wish to move and have 1000 grams of effort to apply. Design a 3rd class lever to do the job, and calculate how far the resistance will move if the effort force moves 2 cm. Have your design checked by your instructor and then obtain the necessary materials and build your machine. Have your instructor check your machine.

Post-Evaluation:

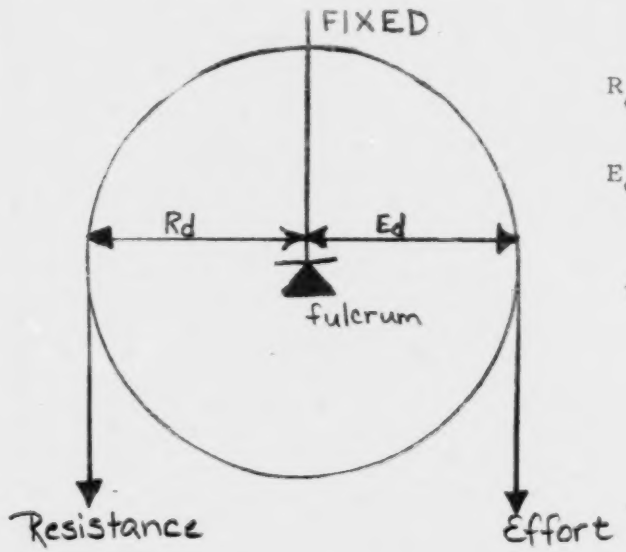
1. List from memory at least 5 examples of a 3rd class lever.

Problem 8

Mechanics - Pulleys

Rationale:

A pulley is a modified lever. A fixed pulley works like a first class lever. The pulley axle is the fulcrum and the effort and resistance arms are equals. Therefore there is no force gain (IMA = 1) when using a single fixed pulley.



R_d = resistance distance

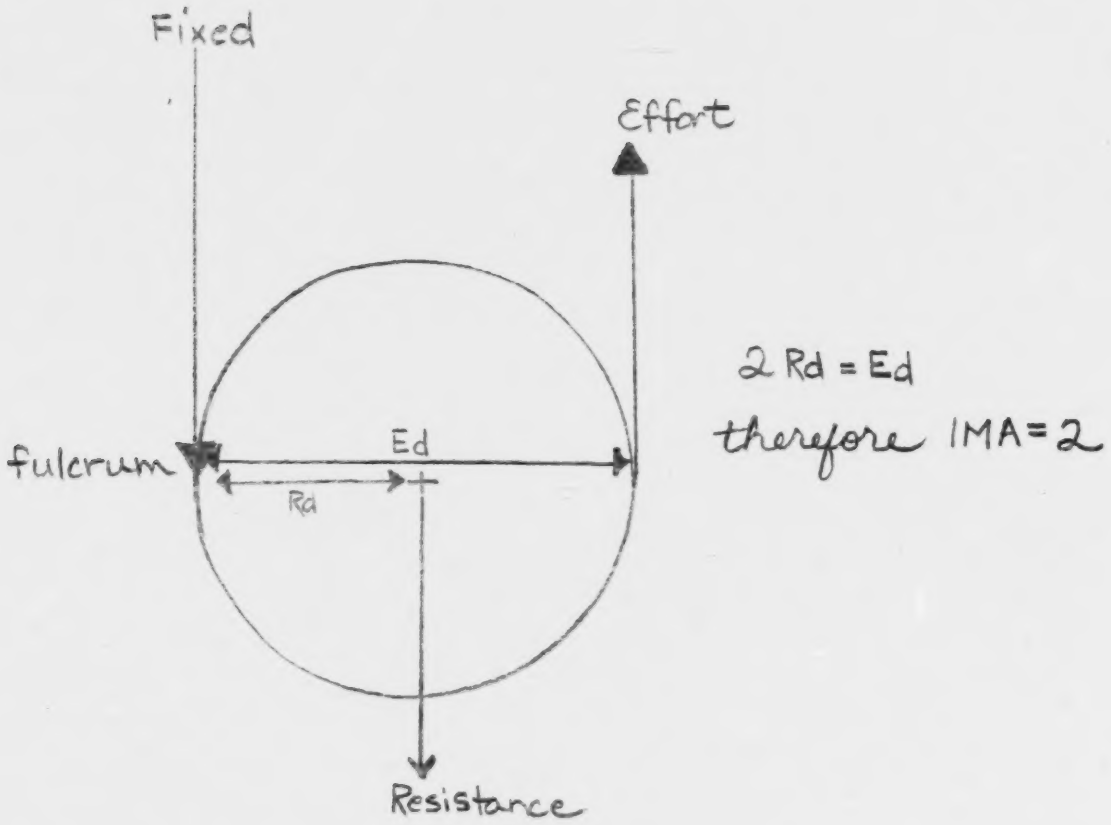
E_d = effort distance

$R_d = E_d$

therefore IMA = 1

If the pulley is attached to the resistance (R) and one end of the rope is fixed then the pulley is equivalent to a second class lever.

(see picture on next page.)



Objectives:

1. Given any pulley system, you will be able to calculate the IMA of a pulley system.

2. Given a resistance and an applied effort you will be able to design and build a pulley system to do the job.

Information Sources:

1. Read pages 109-110 in Modern Science 3

2. Instructor lectures.

Activities:

1. Complete and hand in Sheet M-3.

2. There is a mass of 1000 grams that you must lift with an applied effort 250 grams. Design a pulley system to do the job, calculate the IMA and show your design to your instructor. After your design has been checked obtain the necessary materials and construct your machine and see if it works. Have the instructor check the machine.

Post-Evaluation:

1. Hand in sheet M-3 for grading.

2. You will be graded on the machine you build in Activity 2

The following material has been deleted: How Do Machines Increase A Force II (Pulleys and Gears).

Problem 9

Mechanics - Inclined Plane

Rationale:

The simplest machine known to man is the inclined plane. It has not moving parts and was the basis for man's first tools. The hatchet, wedge, shovel and plow are all examples of the inclined plane.

Objectives:

1. You will be able to calculate the IMA of any inclined plane.
2. Given a resistance and and an applied effort you will be able to design and construct an inclined plane to do the job.

Information Sources:

1. Read pages 105-106 in Modern Science 3
2. Instructor lectures

Activities:

1. Complete and hand in Sheet M-4.
2. You have a toy truck with a mass of 1000 grams that must be lifted a height of 10 cm but you only have an applied force of 300 grams to move it with. Design an inclined plane to do the job. Calculate the IMA and have your design checked by your instructor. After your design has been checked obtain the necessary materials and construct your machine. Have your instructor check your machine.

Post-Evaluation:

1. Hand in Sheet M-4 for grading.
2. You will be graded on the machine you build in Activity 2

The following material has been deleted: How Do Machines Increase A Force III (Inclined Planes and Screws)

SAHUARITA HIGH SCHOOL

CAREER

CURRICULUM

PROJECT

COURSE TITLE: GENERAL SCIENCE

PACKAGE TITLE: ELECTRICITY

BY

LARRY CHRISTENSEN & ROBERT LANE

General Science

Unit IV
Pretest

Electricity

Select the term that best completes each of the following statements. Place the letter of the best term in the blank before the correct question.

_____1. The original voltaic battery was made from (A) a penny in a lemon (B) zinc and copper discs (C) carbon and zinc rods (D) lead plates in acid

_____2. The scientist who proposed that the existence of "animal electricity" was demonstrated when a frog's leg touched two different metals is (A) Volta (B) Galvani (C) Faraday (D) Becquerel

_____3. If a rubber rod is rubbed vigorously, it is (A) charged negatively (B) charged positively (C) discharged (D) uncharged

_____4. High-voltage current sent over power lines is changed to 110 volts outside your house by a (A) generator (B) motor (C) step-up transformer (D) step-down transformer

_____5. The electromotive force that pushes electricity through a wire must overcome (A) current (B) resistance (C) voltage (D) amperage

_____6. A single coil rotating in the field of a horseshoe magnet produces (A) alternating current (B) induced current (C) high resistance (D) high voltage

_____7. When we "charge" a storage battery we reverse the process of changing (A) chemical energy into electricity (B) electricity into chemical energy (C) mechanical energy into electricity (D) electricity into mechanical energy

_____8. The Law of Magnetism states that (A) like poles repel (B) unlike poles repel (C) like charges attract (D) unlike charges attract

_____9. Ohm's Law states that

(A) $\text{Current} = \frac{\text{Electromotive force}}{\text{Resistance}}$ (C) Resistance = $\frac{\text{Current}}{\text{Electro-}}$

(B) $\text{Electromotive force} = \frac{\text{Resistance}}{\text{Current}}$

(D) $\text{Current} = \frac{\text{Resistance}}{\text{Electromotive force}}$

_____10. A group of electric cells forms (A) an electrode (B) an electrolyte (C) a transformer (D) battery

_____11. A magnetized needle suspended in a coil of wire makes a simple (A) galvanometer (B) motor (C) electromagnet (D) electroscope

_____12. If a negatively charged rod attracts an object, the object must be charged (A) negatively (B) positively (C) positively or be uncharged (D) negatively or be uncharged

_____13. Scientists measure current in (A) electrostatic forces (B) ohms (C) volts (D) amperes

_____14. In an electric motor, the device that reverses the current in the rotating coil at the correct instant is the (A) armature (B) cathode (C) commutator (D)galvanometer

_____15. If you place your left hand near an electromagnet, with your fingers bending around the coil in the direction of electron flow, your thumb will point to the (A) North pole of the electromagnet (B) South pole of the electromagnet (C) source of electricity (D) center of the electromagnet.

After you have completed this Pretest bring it to the Quizmaster for checking right away.

General Science

Unit IV
Problem 1

ELECTRICITY

Objective 1 - Demonstrate in five ways how electrons react with other electrons, atoms, ions and molecules.

RATIONALE:

The Van de Graff generator is a device to easily remove electrons from the outer orbits of molecules. For example, if you comb your hair with an insulator (called a comb) you actually scrape electrons off the molecules of your hair. An insulator is a material that conducts electrons very poorly so the electrons stay on the insulator.

If it is dry, the comb is an insulator. The comb now has an excess of number of electrons. We say it is negatively charged.

Your hair is now positive (since there is a greater number of protons and it needs electrons. In a few minutes it will gain electrons from your body or the air.

Sources of Information

Filmstrip:	"Static Electricity"
Book:	The Physical World, read pages 236-239
Filmstrip:	Life "Earth's Magnetism"
Book:	The Physical World, pages 248, 244-247
Book:	Modern Science 3, pages 253, 239-244

ACTIVITY 1

Tear a sheet of paper into small (1 mm x 1 mm) pieces.

These bits of paper will be neutral electrically since their protons and electrons are balanced.

Take your comb and comb your hair several times, causing the comb to become negatively charged.

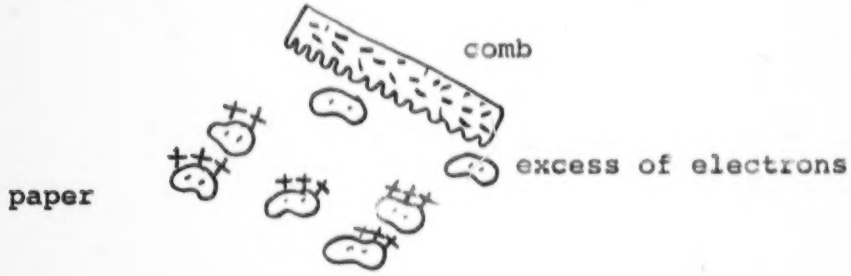
Bring the comb close to the paper. What happened?_____

_____

_____

Unit 10
Problem 1

If the bits of paper were neutral (no charge electrically), why should they have been attracted to the comb? Study the diagram below and write a brief paragraph to explain what you think might have happened.

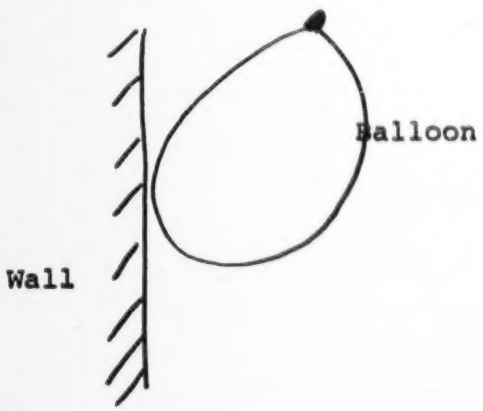


Check with the instructor before going further.

ACTIVITY II

Blow up a balloon. Rub it vigorously on your clothing or hair. Put in on the wall. What happened?

Fill in the positive and negative charges in the diagram below and write a brief explanation of what you think happened.

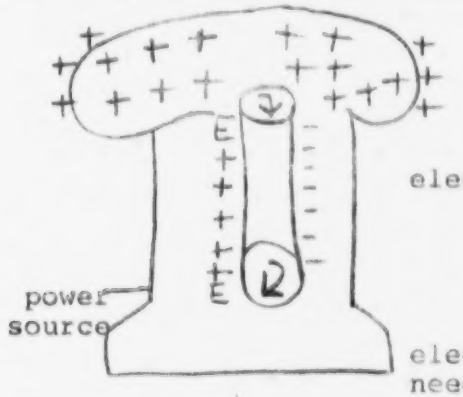


Check with instructor before going on.

ACTIVITY III:

To make it easier to scrape electrons off, a Van de Craff Generator is used. Ask your instructor to show it to you.

As the belt keeps moving, the hollow ball will build up a strong positive charge as electrons are moved from the ball.



electrons move down the belt

electrons are picked off by needle to ground

With the large ball needing electrons, any object brought near the ball will tend to lose electrons to the ball. If you get too close arc will occur. If you measure the spark (arc), the voltage developed is about 30 kv (30,000 volts) per centimeter. DO NOT BE AFRAID. IT IS NOT DANGEROUS.

Turn the generator on. After you run it for about one minute, put your finger up to it. Measure the spark. How many centimeters?_____
How many volts did you get?_____

ACTIVITY IV: (Check your answer with your instructor)

Hold a plastic ball on a string above the generator terminal. (the ball at the top of the generator is its terminal)

What will the plastic ball lose to the sphere when it touches it?_____

Can you explain why the plastic ball is repelled by the sphere after it touches it?_____.

ACTIVITY V:

Take two balloons that have been blown up and tie them to 50 cm of string.

Bring only one balloon to the sphere to be charged. It is now a _____. Bring it to the other balloon. What happened and why?_____

_____

_____

_____

_____

_____

ACTIVITY VI:

Now charge up both of the baloons on the sphere one at a time. Try to bring them together. What happened and why?

_____

_____

_____

_____

Check your work with your instructor before going any further.

ACTIVITY VII:

Charge a plastic coat hanger or rod or test tube by rubbing it lightly on the sphere. Turn on your water faucet slowly. Bring the plastic hanger or rod near the stream of water. What happened and why?_____

_____

_____

_____

_____

Unit IV
Problem 1

What you have been working with up to now in Problem 1 is static electricity. This means stationary charges of either electrons, or positive ions or negative ions.

When electrons are moved along a conductor, like water through a pipe, we call this current electricity.

Check with the quiz-master about what you know.

General Science

Unit IV
Problem 2

ELECTRICITY

Objective 1 - Demonstrate how to use a galvanometer.

Objective 2 - State a rule for the strength of magnetic field around a coil.

Objective 3 - Demonstrate the voltaic pile.

RATIONALE:

To understand how electrons move in a conductor we wish to use an analogy with water.

Pretend you have a rubber hose wrapped seven times around the equator of the earth. Preten the hose is full of water. You have a pump on the end of the hose.

When you push down on the handle of the pump, the water squirts out of the other end of the hose in one second. Notice that all the water did not move to the other end. You pushed water in one end and therefore the water was squirted out the other end.

If you pushed down on the handle, and one second later, the water squirted from the other end--it means the water, 186,000 miles from the handle, was the water that squirted out. (Figure the hose is seven times around the equator which is approximately 186,000 miles of hose).

In effect it is as if the impulse that caused the water to squirt out of the end had traveled 186,000 miles per second which is the speed of light.

Now, the same thing occurs in an aluminum or copper wire. If the wire is hooked up to a battery and the circuit closed, electrons move into one end of the wire. They push the next electrons, which in turn push the next, etc. These electrons that are being pushed are in the outer shells of the atoms of the wire. They are the least affected by the nucleus.

The electrons that move into one end of the wire cause electrons to move out the other end of the wire. At a speed of 186,000 miles per second, the electrons will be pushed out the other end of the wire.

This, then, is called current electricity---where electrons move along a conductor. The best conductors are silver, copper, and aluminum because their out shell of electrons are at energy levels which are easy to dislodge.

Sources of Information:

Filmstrip:	"Static Electricity"
Book:	The Physical World, read pages 236-239
Filmstrip:	Life "Earth's Magnetism"
Book:	The Physical World, read pages 248, 244-247
Book:	Modern Science 3, pages 253, 239-244

ACTIVITY I:

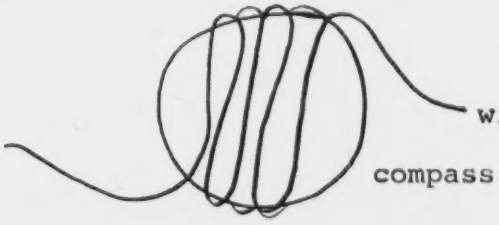
Obtain a flashlight battery, 2 wires, and a miniature light in its receptacle. Show that you know the proper contacts to make the light glow.

Draw a diagram of your apparatus when finished below.

CHECK WITH YOUR INSTRUCTOR WHEN FINISHED.

ACTIVITY II:

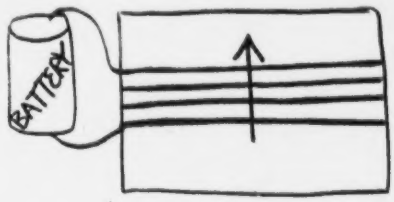
From your instructor obtain a device to detect electron flow. This is called a galvanometer. It can be made by wrapping several turns of wire around a compass as in the diagram below.



Simple
Galvanometer

Unit Iv
Problem 2

Line up the wires of the coil so they point to the magnetic north. This is important. (Magnetic north is 13° to the right of true geographic north in Tucson'



Now record how much deflection of the needle you get in degrees, when you use a flashlight battery.

_____degrees

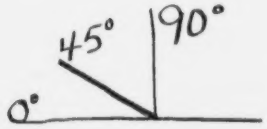
Magnetic north is 13° to the right of geographic North in Tucson.

Now reverse the wire on the battery. What happened?_____

_____

What were the degrees of deflection?

_____degrees



THE DEFLECTION OF THE COMPASS NEEDLE GIVES THE DIRECTION OF THE MAGNETIC FIELD.

A flashlight battery is a dry cell. It is 1 1/2 volts and generally produces from 3 to 5 amperes of current. Look up these new terms in the text books in the reference section of the room and briefly write their meanings.

1-dry cell

2-volts

3-amperes

CHECK WITH YOUR INSTRUCTOR BEFORE GOING ON.

ACTIVITY III:

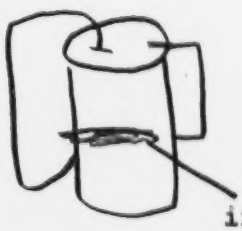
Every conductor through which electrons are flowing is surrounded by a magnetic field.

This discovery was made by a Danish scientist Hans Oersted in 1819. Two years later, a French scientist Andre Ampere found a coil of wire carrying an electric current acted the same way as a magnet, that is, it had north and south poles.

In Activity II, the magnetic field produced in the coil around the compass tended to deflect the needle. The more the turns of wire of the coil, the stronger the magnetic field will be. The stronger the current, the stronger the magnetic field will be.

Using the above information, briefly explain each of the diagrams below.

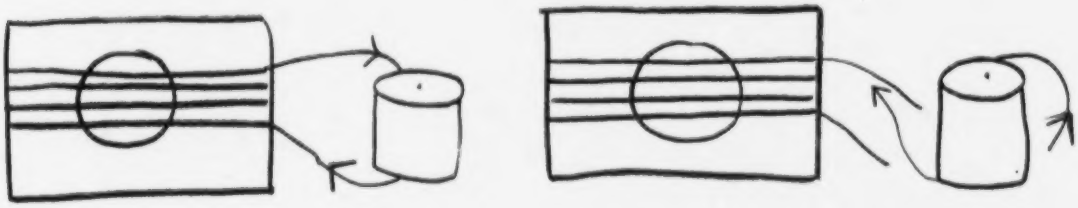
A



B

Why did the iron filings drop in diagram B?

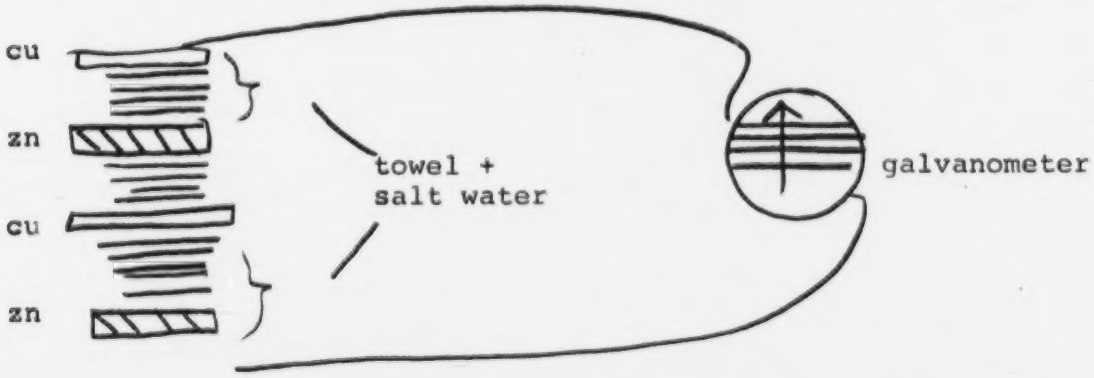
2- When I connect the ends of the two wires in each of the diagrams below the needle of the compass will move. In each case draw in the direction the needle will deflect to. (Remember: The North pole of a magnet always points in the direction of the magnetic lines of force at that place).



ACTIVITY IV:

In this activity you are to make Aleasandro Volta's original battery, which he made in about 1800.

1-Cut up a paper towel into approximately 4 centimeter squares.
2-Stick the squares in salt water (saturate them but they should not be dripping)
3-Obtain or cut up with tin shears, 10 zinc and 10 copper squares. They should be about 4 centimeters square.
4-Alternate your copper and zinc pieces (they must be clean and shiny-use steel wool if necessary.)
5-Place about 5 paper towel squares between each metal piece.



6-Attach the wires from your simple galvanometer to the top and bottom of your pile.
7-What happened?
8-Show your Voltaic Pile to your instructor.

ACTIVITY V:

The voltaic cell which you made was first proposed by Alessandro Volta, an Italian physicist. It involved the use of chemical energy to change two rods with electricity of opposite sign.

Think back to the experiment in which you added zinc to hydrochloric acid. What gas was formed?_____. The zinc became negatively charged. This happened because the zinc atoms that combine with the chlorine , and then float in the solution (the black specks you saw), leave the two electrons from their outer shell behind on the main piece of zinc. Therefore, this main piece of zinc has more electrons than it needs, and it has a negative charge.

The chemical salt solution does the same thing. Therefore, the zinc square in your voltaic pile has a _____charge.

When the hydrochloric acid bonds break, the hydrogen is left with too few electrons. It needs electrons and if there is another metal, such as copper present, it will take electrons from the outer shell of the copper atoms. This leaves the copper atoms with too few electrons and they are now positive ions.

The chemical salt solution does the same thing. Therefore the copper squares in your voltaic pile have a _____ charge.

Now we have negative and positive charges. We have learned in our investigation that the _____charges move towards the _____charges.

Notice that we have changed chemical energy (salt, solution, copper, zinc) into electrical energy (positive and negative charges).

The substance producing the electrical charge are called ELECTRODES. The copper is the positive electrode and the zinc is the _____ _____electrode. The positive electrode is known as the ANODE. The negative electrode is known as the CATHODE.

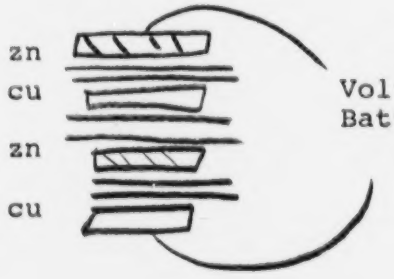
Zinc is the _____electrode and is known as the_____.

Copper is the _____electrode and is known as the_____.

Unit IV
Problem 2

The chemical solution which acts on the electrodes is called the ELECTROLITE. The salt solution is the _____. Since it is a liquid, this kind of voltaic cell is called a WET CELL. Each WET CELL is composed of one square of zinc and one square of copper separated by paper towel soaked in salt solution.

Voltaic Cell



Voltaic Battery

When you make a voltic-pile, you are using several wet cells stacked together. This is a simple BATTERY. A battery is composed of two or more cells.

CHECK WITH YOUR INSTRUCTOR BEFORE GOING ON.

Activity VI:

Obtain problem sheet E1. 3 from the file and perform the experiments as stated. Be sure to take notes and state your results in your notebook.

General Science

Unit IV
Problem 3

Electricity

Objective 1-Demonstrate the measurement of electrical potential (voltage) of various objects with a voltemeter.

OVERVIEW:

You have now seen how electrical current may be produced by chemical as well as magnetic and mechanical means. We will not study the actual generation of large amounts of current unless you care to do an added study, but we need to be able to measure potentials and amount of current in order to use it wisely and be able to protect ourselves from electricity.

Electrical potential (voltage) actually is a measure of the electromotive force (EMF) pushing electrons from one place to another. Since the units used in electricity may all be new to you I will state the relationship between coulombs and volts. *Remember that the coulomb was 6.25×10^{18} electrons passing a given point in one second. A volt of electrical pressure is present when one joule of work will move a coulomb of charge between two points. or

$$1 \text{ volt} = \frac{1 \text{ joule}}{1 \text{ coulomb}}$$

One flashlight cell produces 1 1/2 volts. Two flashlight cells (battery) should produce 2 times as much voltage which would be 3.0 volts - this is the amount of emf or electrical pressure between the posts of the cells.

The voltmeter measures emf between two points in a circuit. Actually the voltmeter measures the difference in electromotive force between the two points where it is connected in a circuit. It is this difference in emf or electrical pressure that causes a current to flow through a wire. The flow is from the area of greatest potential to that of lesser potential.

Why would you not plug a toaster that had 115 volts printed on it into a supply that had 220 volts?

ACTIVITY I:

Obtain problem sheet E 1.5 and read it carefully.

ACTIVITY II:

After asking the instructor any questions you might have about E1.5, perform the indicated procedure and note any observations and results in the proper place.

ACTIVITY III:

After you have practiced measuring the voltage of several sources check with the quiz-master about a demonstration of your skill. Be sure to have your problem sheet completed.

Electricity

Objective - Demonstrate the measurement of current (amperage) in an electrical circuit with an ammeter.

OVERVIEW:

You have just completed a measurement of the pressure (force) causing charges to flow. If there is enough pressure to cause a current then we can determine the current flow with another instrument called an ammeter. The voltmeter is a high resistance in order not to affect the actual flow but only to measure it. A voltmeter was connected in parallel to the circuit but the ammeter is connected in series.

In electricity the greater the number of electrical charges flowing per second the "stronger" the current. One coulomb of electric charge is 6.25×10^{18} electrons or 625,000,000,000,000,000,000.

$$1 \text{ ampere} = \frac{1 \text{ coulomb}}{1 \text{ second}}$$

For example of how this applies see the following:

A steady current flows through an electric lamp for a period of 5 seconds. During that time, 15 coulombs of charge pass a reference point in the filament of the lamp. What is the strength of the current during the 5 second period? Did you answer 3 amperes? Good! If not, see how we arrived at that answer.

$$\text{Current (amps)} = \frac{15 \text{ coulombs}}{5 \text{ seconds}} = 3 \text{ amps}$$

In practice one does not stop to think how many electrons are passing when one is measuring the current so lets look at the actual current measurement.

ACTIVITY I:

Obtain Problem Sheet E 1.6 from the file and read it carefully. Ask the instructor any questions you might have about the problem or explanation.

ACTIVITY II:

After checking any questions with the instructor obtain the necessary materials from the aide and set up the apparatus as pictured.

ACTIVITY III:

Perform the procedures outlined and note your observations and results in the notebook. Check with the quiz-master before taking down the apparatus.

When you are competent in making current measurements check with the quiz-master with your problem sheet.

ACTIVITY IV: (OPTIONAL)

Obtain problem sheet E 1.7 from the file and follow the directions carefully. Complete any problem calculations and bring the completed problem to the quiz-master for credit.

Electricity

Objective 1-Explore skills and knowledge that are useful at home in working with electricity.

Objective 2-Explore some occupations in which electrical knowledge is necessary.

OVERVIEW:

What is a fuse for? What happens when a penny is placed behind a fuse? How do I read an electric meter? Why can't I plug in the toaster, the TV, the lights, and the stove all on the same 30 amp circuit and have them all on? Some of the answers to these questions may be obvious to you but to many people they are not. In the problems of this unit you have no doubt answered some of these but in the optional problems you might find more answers if you are interested.

What are some of the jobs that require electrical knowledge: The obvious ones are construction wiring for lights and appliances, linesman opportunities, appliance repair, motor repair and wiring, electricians for general work, and electrical engineering. General knowledge of electricity may lead to opportunities in electronics also which appears to be an important field in the next 20 years.

What training or skills do you need for occupations in electrical fields? First you generally need a high school diploma with general knowledge of math and science. It is important that you have manual dexterity and for construction and linesman's jobs you must be in good health. What do you like? Outdoor work or nice cool indoor work? Don't overlook the opportunities of getting your training in the service, fellows, as this also allows you to get that obligation out of the way. By the way, girls, there is a growing number of women in assembly and repair departments of electrical companies because they are generally handier with small electrical materials.

Let's look further for more facts and more ideas about these occupations.

Do activities I-IV for minimum credit and activity V for added credit.

ACTIVITY I:

Obtain problem sheet E 1.14 from the file and read it carefully.

ACTIVITY II:

Obtain the necessary material from the aid and perform the simple experiments outlined.

ACTIVITY III:

Write the procedure and observations in your notebook along with answers to the exercises listed in the problem.

ACTIVITY IV:

Check the occupations file in the library about jobs dealing with electricity Make a list of at least 10 jobs dealing with electricity in your notebook.

ACTIVITY V:

Conduct an interview with some one that works in some field related to electricity such as an electrician, a repairman, an auto mechanic, a lineman, or a radio operator. Discuss this interview with the quiz-master.

Electricity

Objective 1-State Ohm's Law and discuss applications in your home and school.

Objective 2-State the uses of series and parallel circuits and demonstrate the proper connections for each type circuit.

OVERVIEW:

You have already made measurements of voltage and amperage and you no doubt found that different lengths of connecting cords caused different amounts of current. Ohm's Law states a connection between the three factors which affect a given flow of current. Stated:

$$\text{current (amp)} = \frac{\text{resistance (ohms)}}{\text{potential (volts)}}$$

or in symbols: $I = \frac{R}{V}$

This relationship can be manipulated like any algebraic formula to find any of the three factors; given the other two. Remember that volts is a measure of electromotive force and E is often used instead of V.

In setting up various circuits it is important to know what power requirements you will need and what kind of resistance will be used in order to know how many devices (appliances) you can add. Since most circuits need some control it is important to know what effect series or parallel connections have on a circuit. For example: a fuse would not be effective if hooked in a parallel and likewise if your toaster and iron were hooked in a series circuit they would both have to be on for either one to work and that would be costly.

Let's see how it works by doing some experiments.

ACTIVITY I:

Obtain problem sheet E 1.8 and read it carefully. Ask the instructor about any items which are not clear to you.

ACTIVITY II:

After checking with the instructor, obtain the necessary materials from the aide and perform the experiments outlined.

ACTIVITY III:

Write a brief statement in your notebook about Ohm's Law and work the exercises in problem E 1.8. Make any observations and results a part of your notebook work.

ACTIVITY IV:

Obtain problem sheet E 1.9 from the file and read it carefully. Ask the instructor about any items which are not clear to you.

ACTIVITY V:

Obtain the necessary materials from the aide and set up the apparatus as outlined and pictured. Perform the experiments listed and be sure you pay close attention to the voltage listed.

ACTIVITY VI:

Answer the exercise questions on problem E 1.9 in your notebook and also note any observations and results from the experiments.

Bring your notebook to th quiz-master when you are ready for an evaluation of the objectives stated. Be sure you know when and why series or parallel circuits are used.

SAHUARITA HIGH SCHOOL

CAREER

CURRICULUM

PROJECT

COURSE TITLE: GENERAL SCIENCE

PACKAGE TITLE: PHYSICAL SCIENCE IN GENERAL SCIENCE

BY

LARRY CHRISTENSEN & ROBERT LANE

CONTENTS

A. Mechanics

B. Electricity

C. Light

Physical Science

Introduction to the Quarter

In the physical world, man's climb from the primitive has always depended upon the use of power. In the beginning it was muscle power, then animal power, and now electrical and chemical power. The total power available has multiplied hundreds of thousands of times in just the last 100 years. In this quarter you will investigate some of the physical features of basic machines, electricity, and light.

Objectives

1. Transportation Cluster

2. Specific Career Objectives

   A. Auto Mechanic
   B. Electrician
   C. Photography
   D. Civil Engineer
   E. Airplane Pilot
   F. Ship's Captain
   G. Aerospace Technician
   H. Aircraft Mechanic

3. Objectives

   1. You will be able to define from memory 9 of 10 of the following terms: fulcrum, ideal mechanical advantage, force, a newton (nt), work, rector, friction, lever, pulley, inclined plane.

   2. You will be able to state from memory Newton's three laws of motion with no mistakes.

   3. You will be able to distinguish between speed and velocity.

   4. Given the mass of an object and its acceleration, you will be able to calculate the force exerted between two bodies.

   5. You will be able to calculate the ideal mechanical Advantage (IMA) of some simple machines.

   6. You will be able to determine the force and direction of the resultant of 2 forces acting on a body by a graphical method.

   7. You will be able to calculate the IMA of a 1st Class lever and list at least 5 examples of a 1st class lever.

   8. Given a resistance and applied effort you will be able to design and build a 1st class lever that would do the job.

   9. You will be able to calculate the IMA of a 2nd class lever and give at least 5 examples of a 2nd class lever.

10. Given a resistance and applied effort you will be able to design and build a 2nd class lever to do the job.

11. You will be able to list the job opportunities and requirements for a career in the field of transportation.

12. You will be able to list from memory 5 examples of a 3rd class lever.

13. Given a resistance and applied effort you will be able to design and build a 3rd class lever to do the job.

14. Given any pulley system, you will be able to calculate the IMA of a pulley system.

15. Given a resistance and an applied effort you will be able to design and build a pulley system to do the job.

16. You will be able to calculate the IMA of any inclined plane.

17. Given a resistance and an applied effort you will be able to design and construct an inclined plane to do the job.

18. Demonstrate in five ways how electrons react with other electrons, atoms, ions and molecules.

19. Demonstrate how to use a galvanometer.

20. State a rule for the strength of magnetic field around a coil.

21. Demonstrate the voltaic pile.

22. Demonstrate the measurement of electrical potential (voltage) of various objects with a voltemeter.

23. Demonstrate the measurement of current (amperage) in an electrical circuit with an ammeter.

24. Explore skills and knowledge that are useful at home in working with electricity.

25. Explore some occupations in which electrical knowledge is necessary.

26. State Ohm's Law and discuss applications in your home and school.

27. State the uses of series and parallel circuits and demonstrate the proper connections for each type circuit.

28. Identify what light is and determine several ways it may be produced.

29. Identify or demonstrate certain properties of light such as illumination, travel, and intensity.

30. Demonstrate light travel, illumination, and image by use of a pin-hole camera.

31. Demonstrate that light travels in a straight line.

32. Identify units such as candles, lumen, and inverse proportion.

33. Demonstrate a standard measure of illumination by actual experimentation.

34. Demonstrate what happens when light hits various types of surfaces.

35. Define and demonstrate the "Law of Mirrors."

36. Demonstrate what happens to light when it passes thru various interfaces such as water-air, air-glass, and glass-air.

37. Identify the index of refraction for various substances such as glass, ice, diamond, and water and describe what this index might be used for.

38. To identify various uses of light, lenses, and mirrors for home, scientific, and industrial uses.

39. Identify the type of lens and demonstrate the arrangement of lenses used to form a microscope.

40. Identify the type of lens and demonstrate the arrangement of lenses used to form a refracting telescope.

41. Identify the type of lens and demonstrate the arrangement of lenses used to form a lens system for a box camera as well as a common 35 mm lens system.

SAHUARITA HIGH SCHOOL

CAREER

CURRICULUM

PROJECT

COURSE TITLE: GENERAL SCIENCE

PACKAGE TITLE: LIGHT

BY

LARRY CHRISTENSEN & ROBERT LANE

General Science

Unit V
Pretest

Light

Answer each of the following questions as fully as possible. Use this sheet (back and front) and any other blanks you need but be sure to put the number of the question on any sheet.

1. What is light?

2. Explain what the law of mirrors means; use diagrams to help explain.

3. How can white light be divided into the seven (six) different colors of light?

4. What are the seven (six) colors of light that make up white light? List them in the order they are normally seen in a rainbow.

5. What names are given to the two areas of invisible light at each end of the visible spectrum?

6. If you wanted to see a baseball game, but a 7 foot board fence was between you and the game; what are some means you could use to watch the game without climbing the fence?

7. Explain why the rays from an auto head light are directed out parallel from the reflector.

Light

Objective 1-Identify what light is and determine several ways it may be produced.

Objective 2-Identify or demonstrate certain properties of light such as illumination, travel, and intensity.

RATIONALE:

For most of the scientific age light has been considered an energy due to the fact that its mass could not be measured as "mass". It is now referred to as radiation and may be detected by a human or electronic eye. Along with light we normally associate heat energy but if at all possible for this unit we would like to have you try to think only of the light and not any accompanying heat. To explain light you might pretend you are an "enlightened" earthling trying to tell someone from a "dark" planet that has never seen light, what it is.

What do we know or can we demonstrate about light? As far as we will be concerned light travels in a straight line until it meets some material object. Intensity of light is measured at the source and is arbitrarily set in "candle power". The illumination varies according to the color of the source and thus a candle varies and it is not really the standard now.

Illumination is actually more useful to us as this actually sets up a standard as to how well lighted a subject is. Intensity and distance from the source are both considered in determining illumination and the units used are: lumens - square meter or 1 footcandle which is the illumination at one foot from a standard candle. The foot-candle is the unit normally used by lighting engineers and photographers to measure illumination.

ACTIVITY I:

Read pp. 305-316 in The Physical World.

ACTIVITY II:

Take a candle from the tray and mount it on a square of cardboard. Light the candle and study it briefly--write your observation in your notebook such as color, steadiness of flame and color, size and shape of flame, and any other observations that appear important.

ACTIVITY III:

Obtain a small flashlight bulb in a porcelain holder such as those used in electricity and hook it up such that "light" is produced. Make observations about this source of light and write these in your notebook also. Do thes two sources of light have anything in common? What? Explain.

ACTIVITY IV:

Obtain a problem sheet ol.1 from the file and perform the activity listed. Answer any questions in your notebook.

Check with instructor before going further--bring your notebook.

ACTIVITY V:

Read or reread pp. 315 and 316 in The Physical World.

ACTIVITY VI:

Obtain a problem sheet 01.3 from the file and perform the activities listed. Answer any questions in your notebook.

Check with the quiz-master and bring your notebook. Ask about alternate experiments if interested.

Filmstrip: SVE "Experiments With Types of Light"

General Science

Unit V
Problem 2

Light

Objective 1 - Demonstrate light travel, illumination, and image by use of a pin-hole camera.

OVERVIEW:

Using the principle that light travels in a straight line until it meets some material object we can make a simple camera from a box and a pinhole. Many good pictures have been made with pin hole cameras and if you have an interest in artistic pictures this is an excellent opportunity to try your luck. More complex cameras are very similiar in construction to a simple pin-hole camera; so lets start at the bottom.

ACTIVITY I:

Obtain problem sheet 01.2 from the file and read it carefully. You might need to discuss the chart on the back page with the instructor or aide before you begin the actual problem.

ACTIVITY II:

Obtain the needed material from the aide or the cabinet if you have permission.

ACTIVITY III:

Perform the suggested procedure and write your observations and results in your notebook.

Check with the quiz-master about evaluation and credit.

QUEST:

If interested you might make a real pin-hole box camera and take pictures of various objects. The instructor will be glad to advise and obtain a limited amount of film or paper for you.

General Science

Unit V
Problem 3

Light

Objective 1 - Demonstrate that light travels in a straight line.

Objective 2 - Identify units such as "candles, lumen, and inverse proportion."

Objective 3 - Demonstrate a standard measure of illumination by actual experimentation.

ACTIVITY 1:

(It would probably be best for two people to work together on this problem).

Read pages 463-473 in Patterns and Processes of Science. Look at experiment 7, page 86 and experiment 9, page 111 in the same book.

ACTIVITY II:

Identify the terms "candle, lumen, and inverse proportion" in your notebook and check with the instructor before going further.

ACTIVITY III:

Reread experiment 43 beginning on page 467 and make sure you have a good idea of what you are going to demonstrate and how.

ACTIVITY IV:

Obtain the needed material and space from the instructor or aide and proceed.

ACTIVITY V:

Make all observations in your notebook along with the data table and graph. If you need help with the graph ask the instructor or the math instructors. Use available graph paper and staple this in your notebook or if you have a loose leaf just add on.

Check with the quiz-master when you have the equipment set up and before you put everything away. Defend your graph for a final evaluation on the problem.

General Science

Unit V
Problem 4

Light

Objective 1 - Demonstrate what happens when light hits various types of surfaces.

Objective 2 - Define and demonstrate the "Law of mirrors".

OVERVIEW:

Light travels in straight lines until it meets a material object; what happens then? What happens next depends upon the material object. If the material is transparent several things can happen such as the light bounces back (reflection), bounces off at crazy angles (scattering), or passes through the object but is bent slightly (refraction). If the material is opaque several things can happen but not refraction. If the material is translucent all of the above can happen but a distinct image is not formed.

Let's look at reflection more closely. The "Law of Mirrors" states that light is reflected so that the reflected and incident rays make equal angles with the normal to the reflecting surface. This law has been applied to flat mirrors or curved ones and should hold up for all.

ACTIVITY I:

Choose one of the sources of information below and use it accordingly. It might be a good idea to take notes on important points in your notebook.

Filmstrip:	"Light and How it is Reflected"
Filmstrip:	"Experiments with the Reflection of Light"
Book:	The Physical World read pages 270-274
Book:	Modern Science 3 read pages 195-200

ACTIVITY II: (OPTIONAL)

Obtain problem sheet 01.7 from the file and read it carefully. If interested in this, obtain the necessary materials from the aide or the cabinet if you have permission. Perform the suggested activities and answer any questions in your notebook.

ACTIVITY III:

Perform one of the two suggested problems below. Both may be done if you desire.

1. Obtain problem sheet 01.5 from the file and read it carefully. Obtain the materials needed after asking any questions you might have about the set-up. After you have the material set up check with the instructor before going further. After instructors' OK--perform any procedures outlined and write the observations and results in your notebook. Check with the quiz-master for credit.

2. Read experiment 7, part B & C in Patterns and Processes of Science pages 86-89. If you choose this experiment make a list of materials needed and an outline of the procedure you plan to follow and have it checked by the instructor. After the OK, obtain the needed materials and proceed. Be sure to measure carefully and write your observations and results in your notebook. Check with the quiz-master before putting the materials back and have him check your notebook for credit.

Check with the instructor about a demonstration with the laser on reflection.

General Science

Unit V
Problem 5

Light

Objective 1 - Demonstrate what happens to light when it passes thru various interfaces such as water-air, air-glass, and glass-air.

Objective 2 - Identify the index of refraction for various substances such as glass, ice, diamond, and water and describe what this index might be used for.

OVERVIEW:

Refraction is that property of light that causes bending of light as it passes from one medium to another. There are two types of explanations for this depending on whether light is a particle or a wave but we won't discuss that now. Refraction is a principle that is important in glasses, cameras, projectors, and almost any substance which man uses to alter the path of light.

Refraction can be important to a fisherman also to an oculist or an optometrist or even to an orthroptist. What is an orthroptist? In this problem you will be asked to answer several questions about refraction and demonstrate simple observations about this.

ACTIVITY I:

Choose one or more of the sources of information below and use it accordingly. It might be a good idea to take notes on important points in your notebook.

Filmstrip:	"Light and How it is Refracted"	
Filmstrip:	"Experiments With the Refraction of Light"	
Book:	The Physical World	read pages 275-280
Book:	Modern Science 3	read pages 200-205

ACTIVITY II:

Choose one of the experiments listed below and follow the directions as listed.

1. Obtain problem sheet 01.8 from the file and read it carefully. Obtain the materials needed after asking any questions you might have about the set-up. After you have the material set up check with the instructor before going further. After instructor's OK perform any procedures outlined and write the observations and results in your notebook. Check with the quiz-master about credit.

2. Read experiment 44 pages 478-481 in Patterns and Processes of Science. If you choose to do this experiment make a list of materials needed and an outline of the procedure you plan to follow and have it checked by the instructor. After being OKed, obtain the needed materials and proceed.

   Be sure to use care in measuring and don't be afraid to ask questions. Work on neatness for your written observations and results in your notebook. Check with the quiz-master before taking down the equipment and have him make a final check for credit.

Have you had any laser demonstrations yet? Are you interested in doing any experiments with it yourself?

General Science

Unit V
Problem 6

Light

Objective - To identify various uses of light, lenses, and mirrors for home, scientific, and industrial use.

RATIONALE:

It is fairly obvious that Americans would be rather lost without light; and especially light from electricity. Some of you have no doubt used kerosene lanterns and also gasoline lanterns for camping or storm use but most homes in the U.S. now have a steadier form of light from electricity.

What do you know about lighting for your reading or study? What do you know about glasses for reading? What do you know about lenses in a camera? What do you know about window glass for a TB sanitarium? All of the above questions have to do with occupations dealing with light. Your most common contact with "Laws of Light" will no doubt be in using a camera, a microscope, or a telescope (whether it be for hunting or astronomy).

Most jobs connected with lenses and light are technical and all require a high school degree. The oculist grinds lenses and the apprentice program for the lower level generally takes two years or more. You need good manual and spatial dexterity to be an oculist plus a good background in mathematics so if that is one of your "impossible" areas this is out for you.

Photography makes an excellent hobby and if you have any artistic ability or sense this hobby can be turned into a profitable one. In fact you might even find it to be a good business for yourself.

Another good hobby is observation with a telescope. This hobby like photography can be expensive but if you like to make things you can get started for less than $20. This "light laws" and hopefully will help you learn more about some of the optical lenses about you. Why are good lenses expensive?

Unit V
Problem 6

ACTIVITY I:

Choose one or more of the sources of information listed below and use it accordingly.

Filmstrip: "Experiments with Color"
Book: The Physical World, read pages 268-271 and 284-289

Book: Life Science Library - Light, read pgs. 70-90

ACTIVITY II:

Make a list in your notebook of at least two uses of lenses in the home, in the science lab, and in industry. (six uses altogether)

ACTIVITY III:

Write a few paragraphs about seeing in humans. How we correct faulty vision and how humans are able to see color.

General Science

Unit V
Problem 7

Light

Objective: Identify the type of lens and demonstrate the arrangement of lenses used to form a microscope.

OVERVIEW:

While the first microscope was little more than a magnifying glass it was a big step for man to be able to polish and shape some glass to form a lens. Anton van Leuxwenhoek (1632 - 1723) is given credit for one of the earlist microscopes and as mentioned in problem 4 his skill at grinding and polishing was a hobby.

The historical development of the microscope is an interesting subject; and one that reads some of the names of early developers will recognize some names of present excellant lenses.

From the simple single lens scope to a compound scope that might have three or more lenses to one that uses electron energy instead of light is quite a story but to appreciate some of the early problems we would like to have you construct a simple magnifying glass with a convex lens and then use convex lenses to form a compound microscope.

ACTIVITY I:

Read Sheet 34, Biology Resouces in Science Classroom Library. You might take some notes or make some microscope sketches in your notebook for interest.

General Science

Unit V
Problem 8

Light

Objective - Identify the type of lens and demonstrate the arrangement of lenses used to form a refracting telescope.

OVERVIEW:

Telescopes were assembled about the same time as the early microscopes and Dutchmen were given credit for the early experimental models. The skills developed by Dutch lens grinders made refractive lenses available and due to the times much experimentation was taking place. Convex lenses were and are used in refracting telescopes and metal tubes connected the lenses. The early telescope was the type you normally see ship captains using to look over the sea.

The newer type optical telescopes are reflective types that have a mirror for collecting light and then a camera or lens system to refine the image. If you are interested in a special project on astronomy we now have an 8" reflecting scope which may be used for special project work. See the instructor for further information.

ACTIVITY I:

Use one or more of the references below:

Filmstrip: "The Mount Wilson and Palomar Telescopes"
Sheet" Earth Sciences 9; "Optical Telescopes" read all pages and especially Gallilean telescope.

ACTIVITY II:

Identify the following terms in your notebook:

a. objective lens
b. eyepiece
c. coma
d. spherical aberration
e. chromatic aberration
f. focal length

General Science

Unit V
Problem 9

Light

Objective - Identify the type of lens and demonstrate the arrangement of lenses used to form a lens system for a box camera as well as a common 35 mm lens system.

OVERVIEW:

As you found in the problem with the pin-hole camera you can take pictures without a lens but for reliable and speedy pictures in all lighting conditions it helps to have lenses. Prefocused lenses are common to all box cameras and given excellent snap-shots at given distances.

For greater variety of lighting and distance it is important to have a lens system that cuts out spherical and chromatic aberration and gives many adjustments for focusing. Photography can be an involved subject in itself so for now lets look only at the lens system.

ACTIVITY I:

Read pages 291-297 in The Physical World and take needed notes in your notebook.

ACTIVITY II:

Identify the following terms in your notebook:

focal length, spherical aberration, chromatic aberration, fixed focus, objective lens, shutter, diaphrogm.

General Science Light

Unit V NAME_____

Place the letter of the best term in the blank before each of the questions or statements below.

____1. An object that emits light is said to be (a) luminous (b) illuminated (c) opaque (d) transparent

____2. Light travels in (a) a circular path (b) an elliptical path (c) straight lines (d) straight or circular paths

____3. In a pinhole camera, the image formed on the film is (a) right side up (b) reversed (c) inverted

____4. The blocking of light produces (a) shadows (b) streaks of light (c) interference (d) dark and light lines

____5. The lighter fringe of a shadow is called the (a) filter (b) penumbra (c) polarized light (d) umbra

____6. A light ray that strikes a reflecting surface is said to be (a) a reflected ray (b) a normal ray (c) an absorbed ray (d) an incident ray

____7. Reflection from a rough surface is said to be (a) diffuse (b) irregular (c) regular (d) translucent

____8. Compared to the object, the image produced by the object in a plane mirror is (a) larger (b) smaller (c) the same size (d) distorted

____9. The dark inner part of a shadow is known as the (a) umbra (b) crest (c) penumbra (d) trough

___10. The bending of light is known as (a) reflection (b) refraction (c) diffraction (d) dispersion

___11. A virtual image is seen when we use a (a) microscope (b) movie projector (c) magnifying glass (d) copying camera

___12. A reflecting telescope consists of a convex lens, a plane mirror, and a (a) convex mirror (b) concave lens (c) magnifying glass (d) concave mirror

___13. The band of colors of light, ranging from red to violet, is called a (a) rainbow (b) spectrum (c) diffraction grating (d) prism

___14. A transparent object is the color of the light that the object (a) transmits (b) reflects (c) absorbs (d) refracts

___15. When an object reflects all light, it appears to be (a) black (b) red (c) green (d) white

II. Explain what the law of mirrors means; use diagrams to help explain.